Claims

What is claimed is:

Sub A1

1. A projecting device comprising:
a light source for generating an incident light beam;
a reflective image module comprising a plurality of controllable reflective surfaces for modulating the incident light beam and generating a reflected image-containing light beam;
a first lens set for concentrating the incident light beam;
a reflective mirror for reflecting the incident light beam from the light source onto the image module through the first lens set; and
a second lens set installed between the light source and the reflective mirror for shortening the optical path from the light source to the reflective mirror;
wherein the optical path of the incident light beam reflected from the image module intersects a plane formed by the optical paths of the incident light beam from the light source to the reflective mirror and from the reflective mirror to the image module at one point.

before filter

shorten light path

2. The projecting device of claim 1 wherein the first lens set is a positive lens of aspherical plane-convex or aspherical biconvex, and the conic of the positive lens is between -1.2 and -0.45.

3. The projecting device of claim 1 wherein the second lens set is formed by two positive lenses, and the first and second lens sets satisfy the following conditions:

$$1.1 \leq \frac{|F_A + F_B|}{F_A} \leq 1.7 ,$$

$$0.5 \le \sqrt{\left|\frac{F_B}{F_{AB}}\right|} \le 1.1 ,$$

over which F_A is the focal length of the first lens set, F_B is the focal length of the second lens set, and F_{AB} is the combined focal length of the two lens sets.

4. The projecting device of claim 1 wherein the incident light beam generated by the light source is concentrated by the second lens set and then the first lens set before it is transmitted to the image module so that the total length of the optical path from the light source to the image module is substantially reduced.

5. The projecting device of claim 1 wherein the light source comprises a curved reflective mirror for reflecting light generated by the light source toward one direction so as to form the incident light beam of the light source.

6. The projecting device of claim 1 wherein the light reflecting angle of each of the reflective surfaces of the image module can be separately controlled by the image module so as to generate the image-containing reflected light beam.

7. The projecting device of claim 6 wherein the image module is a digital micro-mirror device.

8. The projecting device of claim 1 wherein the image module is a reflective liquid crystal display.

9. The projecting device of claim 1 further comprising a rotatable color wheel installed between the light source and the second lens set for altering the color of the

incident light beam generated by the light source.

10. The projecting device of claim 9 wherein the color wheel comprises a round panel having a plurality of transparent color filters installed around its periphery for converting the incident light beam into various colored light beams when the color wheel is rotated.

11. The projecting device of claim 10 wherein the color wheel comprises red, green and blue color filters for converting the incident light beam into red, green and blue incident light beams.

12. The projecting device of claim 11 wherein the red, green and blue color filters are sequentially arranged for generating red, green and blue incident light beams in turn.

13. The projecting device of claim 1 further comprising a third lens set installed between the light source and the rotatable color wheel for focusing the incident light beam generated by the light source onto the color filters.

14. The projecting device of claim 1 wherein the first and second lens sets have positive refractive power.

15. The projecting device of claim 14 wherein the first lens set is an aspherical lens and the second lens set comprises a first lens and a second lens wherein the first lens set and the first and second lenses of the second lens set each comprises a front side and a rear side, and the incident light beam emitted from the light source is transmitted sequentially through the front side of the first lens, the rear side of the first lens, the front side of the second

40+44 deemed a set

lens, the rear side of the second lens, the front side of the first lens set and the rear side of the first lens set.

16. The projecting device of claim 15 wherein the reference data of the first and second lenses of the second lens set and first lens set are listed below:

the index (the wavelength is 0.587 μm) of refraction of the first lens = 1.74,

the index (the wavelength is 0.587 μm) of refraction of the second lens = 1.52,

the index (the wavelength is 0.587 μm) of refraction of the first lens set = 1.52,

the conic of the first lens set = -0.97,

the radius of curvature of the front side of the first lens = infinity,

the radius of curvature of the rear side of the first lens = 14mm,

the radius of curvature of the front side of the second lens = infinity,

the radius of curvature of the rear side of the second lens = 16mm,

the radius of curvature of the front side of the first lens set = -21mm,

the radius of curvature of the rear side of the first lens set = infinity,

the thickness of the first lens = 6mm,

the distance from the rear side of the first lens to the front side of the second lens = 1mm,

the thickness of the second lens = 6mm,

the distance from the rear side of the second lens to the front side of the first lens set = 70mm, and

the thickness of the first lens set = 17mm.

17. The projecting device of claim 15 wherein the reference data of the first and second lenses of the second lens set and first lens set are listed below:
the index (the wavelength is 0.587 μm) of refraction of the first lens = 1.74,
the index (the wavelength is 0.587 μm) of refraction of the second lens = 1.74,
the index (the wavelength is 0.587 μm) of refraction of the first lens set = 1.52,
the conic of the first lens set = -1.00,
the radius of curvature of the front side of the first lens = 60mm,
the radius of curvature of the rear side of the first lens = 12mm,
the radius of curvature of the front side of the second lens = infinity,
the radius of curvature of the rear side of the second lens = 16mm,
the radius of curvature of the front side of the first lens set = -21mm,
the radius of curvature of the rear side of the first lens set = infinity,
the thickness of the first lens = 6mm,
the distance from the rear side of the first lens to the front side of the second lens = 1mm,
the thickness of the second lens = 6mm,
the distance from the rear side of the second lens to the front side of the first lens set = 70mm, and
the thickness of the first lens set = 17mm.

18. The projecting device of claim 15 wherein the reference data of the first and second lenses of the second lens set and first lens set are listed below:
the index (the wavelength is 0.587 μm) of refraction of

the first lens = 1.74,
the index (the wavelength is 0.587 μm) of refraction of the second lens = 1.52,
the index (the wavelength is 0.587 μm) of refraction of the first lens set = 1.52,
the conic of the first lens set = -0.97,
the radius of curvature of the front side of the first lens = infinity,
the radius of curvature of the rear side of the first lens = 15.5mm,
the radius of curvature of the front side of the second lens = infinity,
the radius of curvature of the rear side of the second lens = 17mm,
the radius of curvature of the front side of the first lens set = -21mm,
the radius of curvature of the rear side of the first lens set = infinity,
the thickness of the first lens = 6mm,
the distance from the rear side of the first lens to the front side of the second lens = 1mm,
the thickness of the second lens = 6mm,
the distance from the rear side of the second lens to the front side of the first lens set = 70mm, and
the thickness of the first lens set = 17mm.

19. The projecting device of claim 15 wherein the reference data of the first and second lenses of the second lens set and first lens set are listed below:
the index (the wavelength is 0.587 μm) of refraction of the first lens = 1.74,
the index (the wavelength is 0.587 μm) of refraction of the second lens = 1.52,

the index (the wavelength is 0.587 μm) of refraction of the first lens set = 1.52,
the conic of the first lens set =-0.97,
the radius of curvature of the front side of the first lens = infinity,
the radius of curvature of the rear side of the first lens = 18.5mm,
the radius of curvature of the front side of the second lens = infinity,
the radius of curvature of the rear side of the second lens = 17mm,
the radius of curvature of the front side of the first lens set = -21mm,
the radius of curvature of the rear side of the first lens set = infinity,
the thickness of the first lens = 6mm,
the distance from the rear side of the first lens to the front side of the second lens = 1mm,
the thickness of the second lens = 6mm,
the distance from the rear side the second lens to the front side of the first lens set = 70mm, and
the thickness of the first lens set = 17mm.

20. The projecting device of claim 1 further comprising a projecting module for projecting the light beam reflected by the image module onto a screen.

21. The projecting device of claim 20 wherein the angle formed by the projecting light beam and the normal line of the image module is between 2 to 18 degrees, the angle formed by the optical axis of the first lens set and the normal line of the image module is between 21 to 35 degrees, and the angle formed by a line defined by projecting the optical axis of the first lens set onto the surface on which

the image module is located and the normal line of a plane formed by the projected light beam and the normal line of the image module is between -48 to -68 degrees.

22. The projecting device of claim 1 wherein the incident light beam produced by the light source will be transmitted along the direction of the optical axis of the second lens set, and wherein the angle formed by the optical axis of the second lens set and the normal line of the surface formed by the projecting light beam and the normal line of the image module is between 0 to 15 degrees.

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